

# High street changeability: the effect of urban form on demolition, modification and use change in two south London suburbs

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**Abstract.** *Adaptability and resilience are recognized as essential elements of urban sustainability, yet they remain elusive as propositions supported by empirical research. In the research presented here the affordance of change and continuity – here termed changeability – is investigated through a comparative historical study of two suburban centres in London – Surbiton and South Norwood – which have matured differently, despite many extrinsic similarities. Their development c.1880–2013 is examined through the analysis of digitized historical maps, building use and space syntax analysis of their street plans. Buildings on busy, but not necessarily the busiest, streets in small town centres are said to be the most changeable since they can accommodate a variety of non-domestic uses. Such streets tend to facilitate incremental building modifications and cyclical redevelopment on wide-fronted plots.*

*Keywords: change, adaptation, urban development, town centres, London*

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The research presented here examines how urban form affects change and continuity in small town centres. Susceptibility to change is now recognized as an essential element of urban and suburban architectural sustainability (Griffiths *et al.*, 2008; Hillier, 2009; Penn *et al.*, 2009; Schneider and Till, 2007). Yet these concepts remain elusive in empirical research. Although recent work by Davis (2013) on mixed commercial-residential buildings and Holliss (2015) on ‘live-work’ spaces has made substantial progress in relation to understanding building adaptability, equivalent work exploring

the typomorphological dynamics of building change as an urban scale phenomenon is relatively uncommon. As a consequence, this research is directed towards identifying the mechanisms through which urban form affects ‘changeability’ in town centres, first by examining earlier theories and research in the field, and secondly, through comparative case studies of two town centres, South Norwood and Surbiton, both in South London. The empirical work, we argue, demonstrates how the historical interplay of accessibility, block structure and land use has influenced building change. The analysis in turn informs the

broader question of the interrelationship of urban form, socio-economic change and the resilience of small centres, and to explain *why* the two centres, which are in many respects rather similar Victorian railway suburbs, present strikingly different patterns of building change.

High streets have played a key role in the historical development of both centres. Our research suggests how the particular spatial-morphological properties of suburban high streets afford both change and continuity in the use of buildings, incremental redevelopment, and the possibility of a socio-economically diverse built environment. Such diversity, it is argued, contributes to the socio-economic resilience of the centres by perpetuating a process of continuing morphological transition. This self-generative source of sustainability is an essential, if often overlooked, aspect of the long-term viability of suburban centres.

It is furthermore proposed that a more refined knowledge of morphogenetic *processes* can help to shed light on the proper role of contingency in urban planning, where it is so often lacking, and lay the foundations for the development of improved post-design processes (Porta and Romice, 2010). There is, however, currently little readily applicable information that could help planning and design practice to progress from implementing merely stylistic patterns to the deployment of patterns of the ‘contents, contexts and consequences of space’ (Garcia, 2009, p. 8). Contemporary computational tools could enable this progression, if it were easier to embed uncertainty and contingency into them (Verebes, 2013). To tackle this theoretical and methodological challenge the phenomenon of spatial-morphological change and resilience needs to be better conceptualized systematically and in relation to the complexity of historical built forms. For this to happen, investigations of the materiality of urban change are needed. As Jacobs (1961, p. 174) noted, time is both the ‘constructive’ quality and an ‘indispensable’ factor in creating the complex social life of cities.

## Theoretical framework

### *Defining changeability*

The concept of changeability is the capability of a system to undergo transition over time so that it remains fit for purpose (Ross *et al.*, 2008; Schmidt *et al.*, 2010). What makes changeability challenging to deal with is the need to develop a conceptual framework for urban change in order to examine it analytically, not least because change and continuity can work at different scales simultaneously (Kropf, 2001).

What, one must ask, *is* change, in a town centre? Changes to individual buildings are, arguably, relatively unimportant if the overall mixture of building types, uses and people remains in equilibrium and the centre retains its character in relation to the larger urban context. Individual changes (or the lack of them), however, are relevant if their *aggregate* effect alters the character of the centre. Depending on whether a town centre is defined as the sum of its parts – buildings and people, for example – or through its position in a larger urban system, the perception of change may be different. It is therefore necessary to acknowledge both different units of change, as well as understanding how they are interdependent: namely, the extent to which they can change or be changed by each other. Change can be both ‘formative’ (for example, steady renewal) or ‘transformative’ (Kropf, 2001, p. 31), when the aggregation of incremental, lower-level changes alters the whole perception of an area, and citizens, businesses, developers and planners start relating to it in a different way.

Change is mediated not only at different scales but also through the various *characteristics* of town centres. The appearance of a centre, for example, may stay the same while its function may change and *vice versa*. A study of changeability must therefore recognize various aspects of the built environment in which change is manifested. For instance, the physical, social and functional aspects, and the cultural and institutional backgrounds in which they are embedded, can each have different degrees of changeability (Smeets, 2007).

	MODIFICATION	MOVEMENT
PHYSICAL	Modification of structure	Accessibility
FUNCTIONAL	Alteration of use	Diversity of the environment
SOCIAL	Regulation of interaction	Connectedness
CULTURAL	Possibility of identification	Inclusivity
INSTITUTIONAL	Empowerment	Freedom of movement

**Figure 1. Aspects of changeability in the built environment.  
After Törmä (2011).**

Lefebvre (1991) has theorized three dimensions of space: *conceived*, *perceived* and *lived* space. He argues that professionals working with space, such as designers, scientists or politicians, tend to focus on abstract, *conceived* space. In this conceptual space, change is captured in maps or drawings. However, from a user's point of view, understanding changeability in the *lived* or *perceived* experience not only means change applied to a specific location, but also change that unfolds through an individual's movement between given locations. Movement creates new opportunities to conceptualize changeability: not only in the sense of the capability to change the use of a certain space, but also as a systemic capability of diverse environments that mediate change in the world of human experience.

Figure 1 illustrates these ideas diagrammatically through a matrix of change and movement 'enablers'. These ideas can be developed in relation to previous research on processes of change in historical town centres. This study focuses on the physical, functional and social aspects, using buildings as the units of change, and recognizes modification and movement as enablers of changeability. Research using a topological theory of urban form – space syntax (Hillier and Hanson, 1984) – is combined with research based on 'figure-ground' – voids and solids – to examine the interplay between spatial and geometrical properties. Studies of change in urban form are then compared to studies of city blocks and building types to better

understand the influence of urban form on building typology (Moudon, 1989).

*Physical changeability: modification and accessibility*

Physical changeability entails a degree of *redundancy* in a structure, whether of a building or a city (Davis, 2013; Hillier, 1999; Holliss, 2015; Schneider and Till, 2007). Redundancy, both in space and access, catalyses physical changeability: it produces more choice in how street blocks and/or individual buildings can be arranged. Space syntax research has demonstrated that redundancy in street networks develops typically in urban centres. It results from a self-regulating process in which the most accessible parts of the street network benefit from relatively high levels of through movement. Historically, this process produces a densification of the local grid structure, distinguished by an accumulated concentration of diverse economic activities that benefit from increased footfall, maximal building frontage and easy access to buildings (Dhanani and Vaughan, 2013; Hillier, 1999; Vaughan and Griffiths, 2013). Access and movement thus link built form and urban economies.

High accessibility explains why sites in central locations tend to have higher land values. Switzer (1963) has argued that increases in site value stimulate redevelopment more than any other factor. An expanding economy

raises rents proportionally more in central areas and consequently creates pressure for redevelopment where the earning power of buildings is not on a par with the increased land value (Lean and Goodall, 1966). Societal changes, such as the growth of national property companies in the early-twentieth century, have accentuated this phenomenon (Whitehand, 1984).

A relatively central location and accompanying increase in economic value are agents of physical change, but smaller-scale morphological features also play a role in how change takes place. Porta and Romice (2010) argue that in built-up locations relatively small plot size is a key enabler of the incremental change that is a precondition of urbanity. ‘Figure-ground’ research has revealed that, for both urban and suburban locations, additional access, as in through-plots or plots abutting the street with a wide frontage, encourages differentiation within plots as it enables subdivision and typological alternatives. Street blocks with narrow and deep plots, in contrast, are more prone to major structural change where development pressures are high (Siksna, 1998; Whitehand and Carr, 2001). However, these processes of change are not simply uniform and accumulative. Historical land-use patterns embedded in the tissue of streets and plots also serve as a constraint on more drastic change (Vaughan *et al.*, 2010b; Whitehand, 2001b).

Redundancy in the spatial structure is a facilitator of physical change, but local building types and individual modifications play a role in how changes aggregate. Similar modifications to buildings tend to diffuse to neighbouring ones and cluster in space and time (Whitehand and Carr, 2001). Hillier and Hanson (1984) conceptualize the built environment as a source of social information encoded in the ‘configuration’ of space and transmitted through time. Such an informational dynamic may give rise to self-reinforcing cycles (Kropf, 2001) in the sense that a street configuration provides a mechanism for changes to diffuse, and typological uniformity provides a basis on which changes can multiply from neighbour

to neighbour. Together, the street configuration and building typology constitute what Allen (1997, p. 30) calls a ‘field condition’: a spatial matrix structure that allows influences to disperse and that is capable of unifying diverse elements. At the macro-scale, regional and periodical uniformities emerge and form morphological regions and periods (Whitehand, 2001a).

In summary, access to structure appears both to trigger and enable physical modification. This is a multi-scalar proposition. It applies as much to access to building parts and spaces, which increases the adaptability of buildings (Schneider and Till, 2007), as to accessibility to local centres through regional transportation infrastructure, which appears to influence their adaptation to societal changes (Krenz, 2015, p. 72:15). The accessibility of cities, however, is constituted by an ever-shifting arrangement of streets and buildings. In this ‘field’ each change has repercussions that are not entirely predictable. Nor do they occur on a *tabula rasa*, but are affected by local field conditions and history.

*Functional changeability: alteration of use and diversity*

Functional changeability refers to the ability of built forms to accommodate a range of functions rather than any specific function: it is about generality (Hillier, 1999), and in that sense applies to all spaces, from rooms to cities. Just as the dimensions of rooms allow for multiple uses (Schneider and Till, 2007), so urban grids provide a range of locations from segregated to central (integrated), within which different actors and *actions* can be accommodated (Hillier, 1996). Generality can be related to redundancy through the notion of the ‘intelligibility’ of a spatial configuration, meaning the facility with which one can comprehend the elementary spatial structure of the city from one’s particular location within it (Hillier, 1996). Intelligibility, therefore, increases the ease of *using* the city and finding different places. When redundancy both in space and access are combined in an

intelligible way, the result is a form that lends itself to diverse uses.

In an urban setting, functional changeability is not simply a matter of amenable spatial structure. The uses and customs that have accumulated in the urban built environment are important. Penn *et al.* (2009) note of Clerkenwell that a diversity of uses and users spreads the risks of external disruptions and enables quick adjustment to changing circumstances. This diversity arises from competing forces driving uses together or apart (for example, businesses that cluster to compete with each other or disperse to find new customers), and from intelligible localities that allow clusters of activity to arise. However, accessibility and intelligibility can render a street excessively used, leading to development pressures and ‘mainstreaming’ that may be detrimental to diversity, as in some central London shopping streets dominated by international-brand stores (Hall, 2011; Penn *et al.*, 2009). Similarly, very large plots do not lend themselves to gradual change over time and therefore do not support diversification of streets (Porta and Romice, 2010).

Earlier research by the authors on the growth of London’s suburban town centres showed that a street configuration that channels local and longer-distance movement both to and through a town centre, provides grounds for diverse socio-economic activities (Vaughan and Griffiths, 2013). Davis’s (2013) research complements these findings from a building typological point of view. It shows how the shop-house type emerges in streets where footfall is suitable both for residential and commercial purposes. Diverse activity may, in fact, be a precondition for the emergence of town centres as well as being a key to their long-term resilience in the face of the massive socio-economic changes of the twentieth century (Vaughan and Griffiths, 2013). Socio-economic activity in London’s suburban centres does not arise only from purposeful visits to a single destination. It arises in many ways and may not have been planned in advance. A visit to a town centre may be a by-product of other, often more leisurely or spontaneous activities on the way. It is the intermingling

of individual habits and the resulting collective emotional investment in place that sustain diversity (Seamon, 1979; Vaughan, 2015, ch. 7).

#### *Social changeability: regulation of interaction and connectedness*

All space is socially produced and appropriated in varying degrees according to the demands of specific social relations (Lefebvre, 2009). These appropriations are constantly renegotiated. Social space is produced through everyday interactions, in which abstract social structures are exploited and re-shaped to make sense, and communicate and co-ordinate actions between people (Giddens, 1984). Accessibility enables the social appropriation of space. It creates or eliminates the co-presence of people living in and passing through an area that makes up a ‘virtual community’ – that is the patterns of co-presence one might anticipate in a given area with a certain structure and density (Hillier, 1996, p. 141). The configuration of morphological tissue that generates intensification of encounters and socio-economic ‘events’ in places like high streets, becomes a source of social memory that carries the sense of community from the past to the future (Griffiths, 2015).

Social changeability, then, is primarily an expression of how the qualities of a locale permit modification of the virtual community structure and the social meaning of space: for example, by introducing various spaces of encounter, both random and intentional. It is also how a locale affords movement along the continuum of spatial integration-segregation and social informality-formality, and realization of different spaces catering for sociability, as well as privacy.

Social changeability is not necessarily desirable: the search for social advantage is often associated with various exclusionary tactics. Psycho-social boundaries are created: for example, traffic arteries or geographical features may be used to favour the ‘right kind’ of neighbours (Sies, 1997; Watt, 2009). These processes create tensions where social

advantage and disadvantage are in close physical, but not social, proximity. Mary Sies (1997) has observed how, in suburbs that have retained their exclusive status, socio-economic persistence needs consistent community support that articulates and preserves the value of the area. The support stems from the perception that such upkeep is worth the effort, a perception formed through local informal networks, often perpetuated through social space. Places like high streets may have a robust 'being-in-memory' quality, but their social meaning can be contested. Narratives of places can sustain, but also challenge and alter, specific cultural associations of a local centre as a place of sociability.

### Case studies in changeability

In relation to this theoretical framework, the two suburban centres selected for comparative study were examined to ascertain how their buildings had changed over time as the centres expanded. A particular focus of attention was the morphological properties that lent themselves to building adaptation.

These two suburban centres in London are appropriate for this type of study of change because their development has been relatively rapid and different development phases are clearly pronounced. They are both in the largely inter-war 'doughnut' zone between the north-south circular road and the M25 orbital road. Their histories are sufficiently similar to control for overarching socio-economic circumstances, yet their current conditions are different enough to provide a valid comparison of the influence of urban form in their contrasting trajectories of socio-economic development.

Three kinds of change that could be extracted from historical records are examined: building demolitions and modifications that represent physical changeability; and building-use changes that represent functional changeability. The discussion of social changeability draws on observation studies conducted by Vaughan *et al.* (2010b). Three types of variables that could hypothetically predict change

were investigated; the variables represent the topological and the figure-ground characteristics of urban form: the centralities of street networks, building and plot dimensions, and the functions of buildings and street segments, such as the clustering of changes in the street.

The high streets focused on here are those street segments that feature the highest density of non-domestic land use (Griffiths *et al.*, 2013). More precisely, the high street segments are those in the top quartile of the amount of ground-floor, non-domestic land use per segment in each centre. Broadly, this definition coincides with Victoria Road in Surbiton and High Street in South Norwood. The case study sites and the main streets containing 'high street segments' are shown in Figure 2. Figure 2 also shows the results of space syntax analysis of *choice*, which measures how central any given street segment is likely to be for routes taken within a specific search radius. The results are coloured in a range from red to blue to represent the range from high to low values, respectively (see full explanation in the following section).

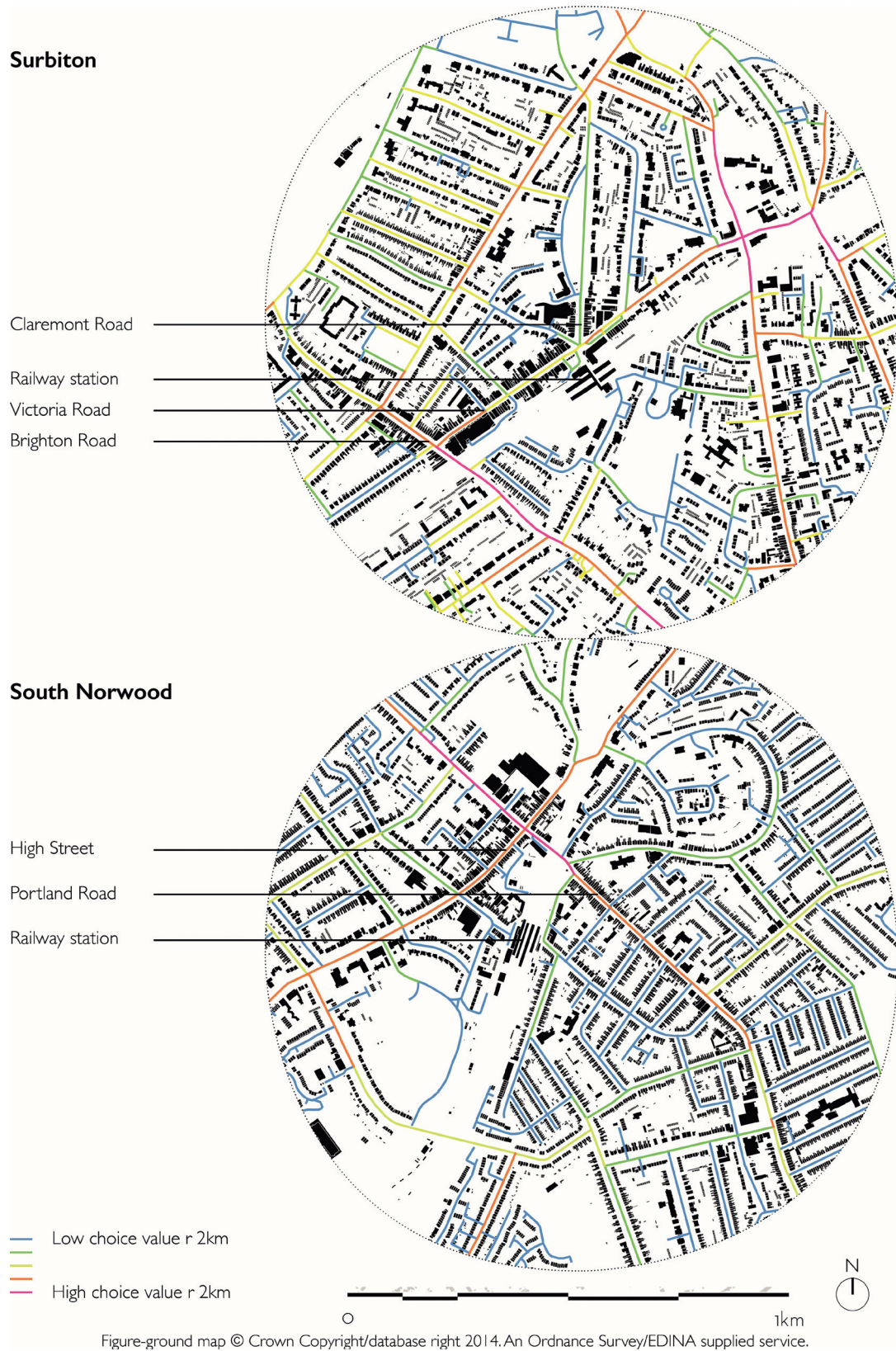
### Methodology

#### *Mapping change in buildings and its correspondence to urban form*

Changes to the building footprints and building uses were mapped as follows:

- Demolitions (disappearance of a building shape on the map);
- Modifications: external additions, omissions, divisions and consolidations of building footprints (a minimum of 0.25 has been set to capture changes in the footprint area to allow for inaccuracies in the maps);
- Changes in the type of ground floor use (retail, community services, commercial services, catering (such as pubs), and residences).

Changes in buildings were studied in relation to the morphological variables listed in Table 1: building footprints, block shapes and the topological properties of the street segment



**Figure 2. Figure-grounds, high street segments, stations and choice at 2 km radius in 2013.**

**Table 1. The morphological variables**


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1.	Topological variables of the street scene (computed with depthmapX programme (Varoudis, 2011–14))
	Space syntax measure of street segment integration and choice for a range of search radii from 400 m onwards (Hillier and Iida, 2005)
2.	Geometric variables (measuring the plot and building shapes)
	Building street frontage length
	Building footprint area
	Proportional width of the building (frontage length/footprint area)
	Plot efficiency (building area/plot area)
	Plot area
	Proportional width for the plot (perimeter/plot area) (assuming that plots are deeper than their width)
3.	Functional variables (Measuring changes to buildings and streets)
3.1	Building and plot
	Building use type (domestic or non-domestic, or the sub-categories of non-domestic uses)
	Building use type change (since the previous time period)
	Total numbers of use changes in the building since the first time period
	Number of building modifications
	Building demolition
	Plot redistribution (plot division or consolidation)
3.2	Street segment (segment densities calculated as: number of non-domestic uses divided by segment length)
	Density of non-domestic floor uses in the street segment
	Density of building use changes in the street segment
	Density of building use continuities in the street segment
	Density of building modifications in the street segment
	Density of building demolitions in the street segment

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in which buildings were situated. Point bi-serial correlation coefficients between the building changes and the morphological variables were calculated for all the statistically significant correlations.

#### *Geographical data sources*

The analysis was based on GIS data produced for the interdisciplinary ‘Adaptable suburbs project’ (Vaughan *et al.*, 2010b). Maps (Ordnance Survey County Series 1879, 1913, 1954; Ordnance Survey County Series 1880, 1913, 1955) and business directories (Kelly, 1915, 1956; Phillipson, 1876; Ward,

1874, 1915, 1956) were assembled on a GIS platform to study change in the town centres compared with a contemporary land-use survey conducted for 2013. The contemporary map was available in vector format (Ordnance Survey MasterMap Topography Layer, 2013). Building footprints in the historical maps were converted into vectorized figure-ground maps in GIS format (Dhanani and Vaughan, 2013). Plots were then redrawn manually in GIS software. Where the addresses of historical buildings could be identified on the map, their matching land use, as listed in the business directory, was geocoded to the corresponding building footprint. The contemporary building uses were surveyed on site and

similarly geocoded in the GIS. Data on the year of construction (using information obtained from Croydon Council, 2008), close reading of the maps and visual on-site evaluation provided the basis for identifying features of demolition and modification. In addition, street network analysis was conducted using the space syntax measures of *integration* and *choice*, which analyse the configuration of street segments as they form part of a network. In space syntax analysis, *integration* measures the proximity of one street segment to all other street segments within a specified search radius; whilst *choice* measures the centrality of a street segment on routes between any two street segments within a specified search radius. A street segment will have a higher value of choice if it is traversed many times on the shortest angular path between a pair of origins and destinations. The space syntax values were computed with depthmapX software (Varoudis, 2011–14). The space syntax models were based on historical and contemporary road centre line maps of street segments within a 6 km radius (Dhanani and Vaughan, 2013).

#### *Surveyed areas*

The town centre boundaries were initially identified from a dataset produced by the British Government's Department of Communities and Local Government and based on criteria such as the diversity and intensity of land use and pedestrian accessibility (Thurstain-Goodwin *et al.*, 2002). These boundaries were then extended to cover a radius of 800 m from the centroid of the official town centre boundary in order to capture an area within 10 minutes walking distance and so as to include a wider array of land uses, such as industrial activities.

#### *On-site survey of building change*

A case study surveying individual street segments in Surbiton was conducted to form a detailed picture of change: an axonometric

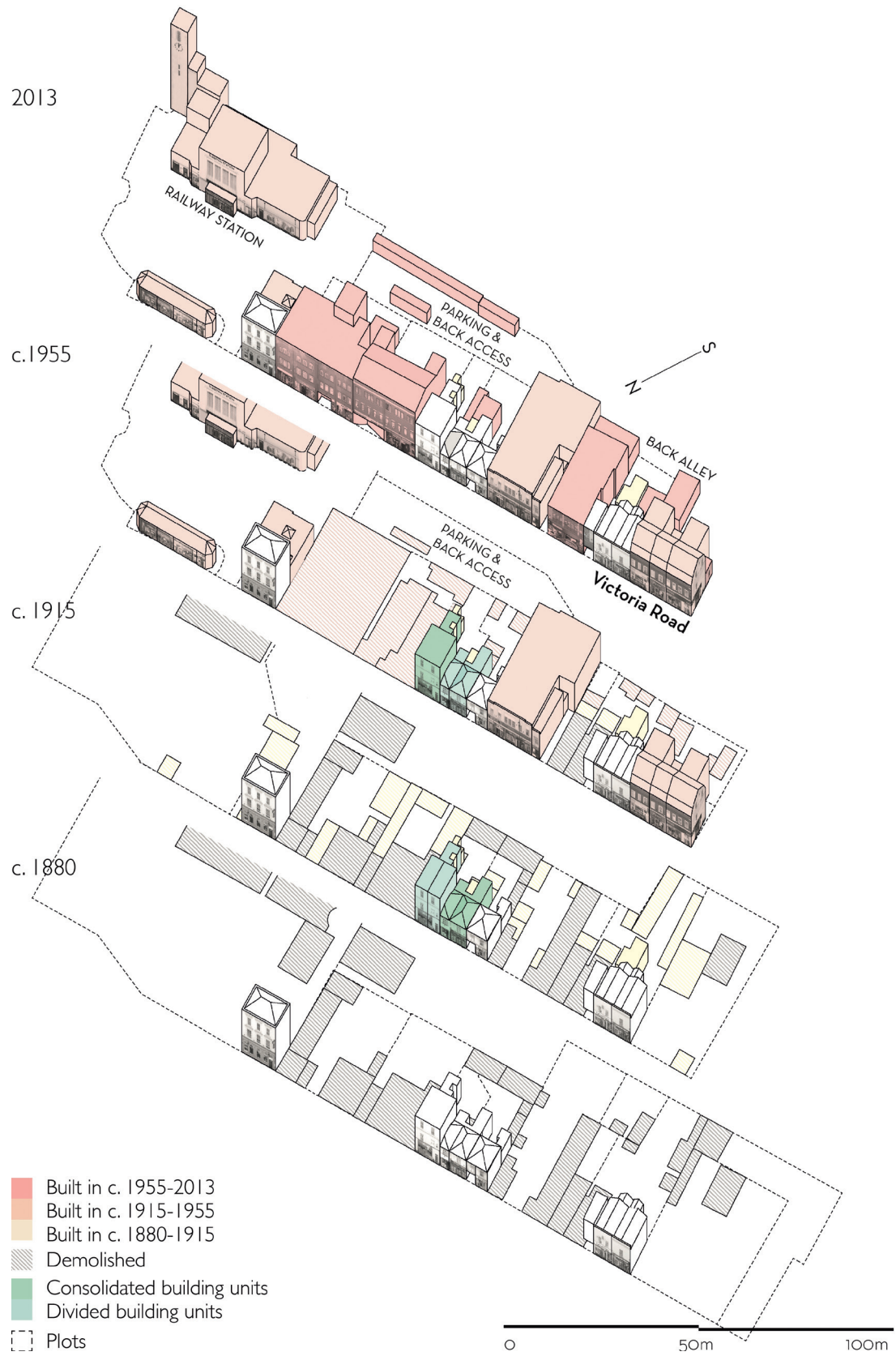
projection of the buildings was drawn with the help of maps, aerial and street photographs of how the surviving buildings were extended, joined into one unit or divided, and also how the plots were configured, built up and redeveloped. The surveyed street segments were chosen to find the cases with the highest counts of demolition, modification and use change per segment over time.

#### **Changeability in the two centres**

The two case-study centres showed similarity in the correspondence between changes in buildings (demolitions, modifications and use changes) and morphological variables described in the previous section. Though both areas were thriving in the early-twentieth century, only Surbiton continues to do so today. South Norwood's high street is to a certain extent regarded as being 'past its prime', with more social deprivation today than in the past (Department for Communities and Local Government, 2011). In this sense Surbiton seems to have been more resilient socio-economically. Given the fact that Surbiton's built form has been more robust in the face of urban development within and around the central area, it seems plausible to suggest that the patterns of street segment accessibility have contributed to changes in the building stock in the two cases. This proposition is explored further.

#### *General findings about change*

Surveys of the three street sides with the highest concentration of changes are presented in Figures 3, 4 and 5. They illustrate how building demolitions, modifications and use changes recur under different spatial-morphological conditions. Figures 3 and 4, featuring high concentrations of modifications and demolitions respectively, are situated either side of a single section of Surbiton's high street, Victoria Road. In both cases, major rebuilding occurred between *c.* 1955 and 2013, and car parks created behind the plots have provided



**Figure 3. Street section with a high amount of demolition – Victoria Road in Surbiton.**

a new access to the rear that has encouraged development, providing evidence for the importance of surplus access on changeability. The rear ends of the plots have changed more than the fronts – an observation consistent with Conzen's (1988, p. 257) finding in his study of Ludlow. Where buildings on plot frontages show greater persistence it suggests that resistance to change might be an aspect of urban form character rather than land utilization of the individual plot.

Remarkably, the south side of Victoria Road (Figure 3) has been much more heavily redeveloped than the north side (Figure 4). On the south side, the relatively wide plots and early industrial character abutting the railway appears to have stimulated development. The north side has narrower plots and more back extensions to existing buildings. Rebuilding on the north side has taken place particularly on corner plots, whereas the mid-block plots have only been developed since they obtained rear access.

Ewell Road in Surbiton shows a high concentration of use change (Figure 5): its land-use diversity predates the development of the current high street and has persistently been high in the space syntax measure of choice, indicating its long-term centrality in the wider network (Griffiths *et al.*, 2010). The original residential buildings, set back from the street, have been extended at the front and back, with access from a back alley. The additional premises have been provided primarily for non-domestic use. The constraint on development stemming from plot narrowness displays a pattern similar to that which Conzen (1960) and others have observed.

Overall, demolition is primarily influenced by plots and the ground-floor dimensions of buildings; use change by the degree of choice (a measure of centrality) and original land use; and modification more or less equally by degree of choice, ground-floor dimensions and land use. In summary:

- Squarer, larger and less efficiently built-up plots are most likely to be demolished and redeveloped.
- A location with high choice around 1 km radius and a large building footprint is

most likely to have modifications to the buildings along with a high amount of land use change.

- For use change, the most common predictors are a history of repeated use change, non-domestic use of the building, adjacent non-domestic buildings and modifications on the same street segment, and choice within a range of 1–3 km network distance. This range suggests that streets that are important for wider-scale (rather than local) movement are more likely to be subject to change, all other things being equal. More broadly, the findings suggest how building and plot dimensions influence physical change in buildings, supporting earlier figure-ground research into how different types of street block change over time (Conzen, 1960; Siksna, 1998; Whitehand and Carr, 2001). The influence of street configuration on building modification and use change recalls Hillier's (1999) notion of 'centrality as a process', in that higher spatial integration gives rise to a process of street grids becoming denser over time, with town centres evolving in and around the highest intensity of network accessibility. The case studies in this paper did not investigate grid densification; instead they and previous 'adaptable suburbs' studies (Vaughan, 2015, ch. 7; Vaughan *et al.*, 2010b) propose that the configurational qualities of the street network (namely the space syntax measures of integration and choice) give rise particularly to the functional diversification of a centre in and around the high street. Differing somewhat from Hillier's (1999) theory of the centrality process, the case studies also imply that the redevelopment and expansion of the building stocks of the centres are more strongly associated with ample size of plots than with the immediate adjacency of spatially central streets.

#### *Physical changeability*

It was hypothesized that physical changeability follows from multi-scalar redundancy in space and access: in the scale of buildings, plots and the street network alike (Davis, 2013; Hillier, 1996; Schneider and Till, 2007;

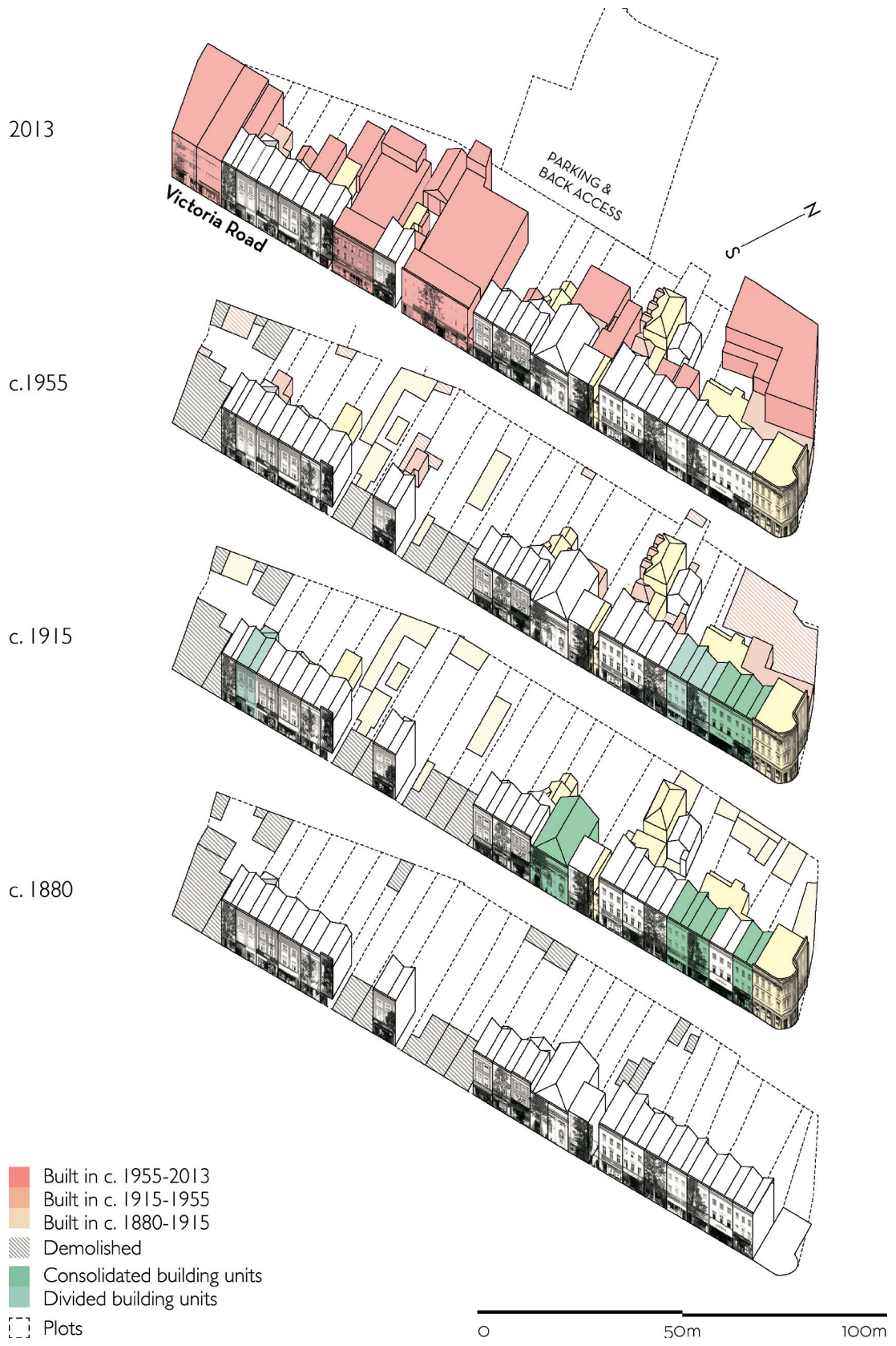


Figure 4. Street section with a high amount of modification – Victoria Road in Surbiton.

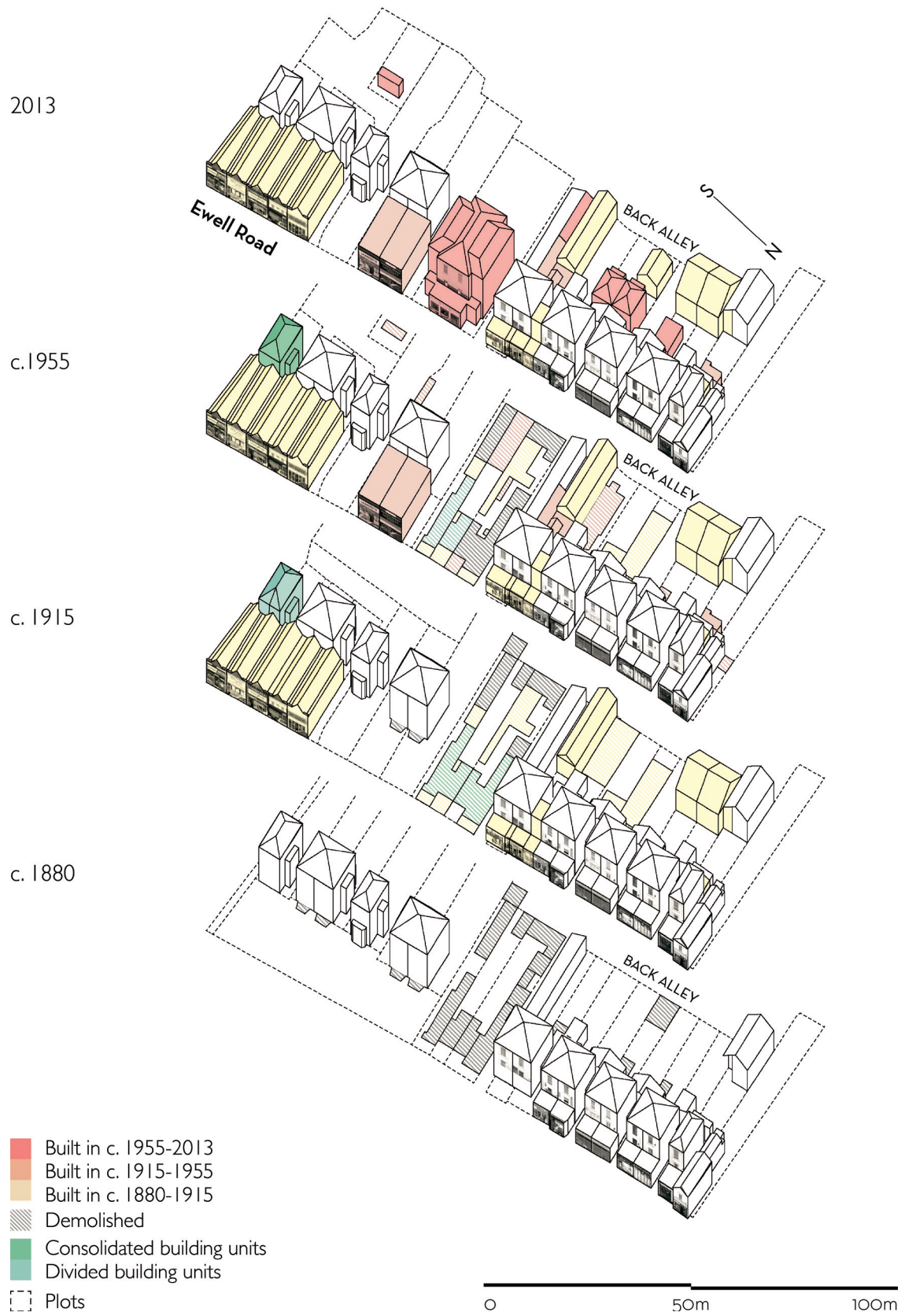


Figure 5. Street section with a high amount of use change – Ewell Road in Surbiton.

Siksna, 1998; Till, 2009; Whitehand and Carr, 2001). Figure 6 illustrates how modified buildings appear typically on street segments that have quite high levels of choice, signifying redundancy corresponding to accessibility in the street network. This is especially the case in Surbiton. Figure 7 compares the locations of demolished buildings in Surbiton and South Norwood, showing a striking difference between the two centres: whereas demolitions appear on the side streets and large plots in both Surbiton and South Norwood, in Surbiton they also feature along the high street itself. With the exception of Brighton Road, Surbiton's high street segments are not among the highest in choice values, whereas in South Norwood, all the high street segments coincide with high choice values. These results suggest that network configuration and changeability are not related in a straightforward linear manner: it may be the case that it is the *active but slightly less busy* parts of the street that are most malleable in small centres such as these, when taking account of the development phase of the centre. The findings regarding South Norwood's demolition rates indicate that if accessibility is too high, it can be detrimental to a small centre. Indeed it has been argued that traffic is a major threat to London high streets (Gort Scott Architects and UCL The Bartlett School of Planning, 2010) and it can cause a tension between a street trying to be both a 'link' in a traffic network and a 'place' in which to live (Jones, 2007).

Figure 7 reveals how Surbiton's high street has been much redeveloped, whereas South Norwood's high street has undergone relatively little redevelopment. Since *c.* 1915, demolitions have consistently taken place on less active streets in South Norwood. This phenomenon has quite possibly contributed to the relative decline of the town centre. In his study of changes in the town centres of Northampton and Watford in the mid-twentieth century, Whitehand (1984) shows how building shape and size changed in the two centres as they became more integrated in the national property market. Chain stores moved into large, purpose-built accommodation and the

relative number of local concerns involved in changing the townscape decreased. And at the same time there was a decline in a historical sense of place among the agents of change (see also Whitehand and Whitehand, 1984). Conzen (1988) refers to this phenomenon as a type of 'secular human agency' (as opposed to morphogenetic agency) acting on historical townscapes.

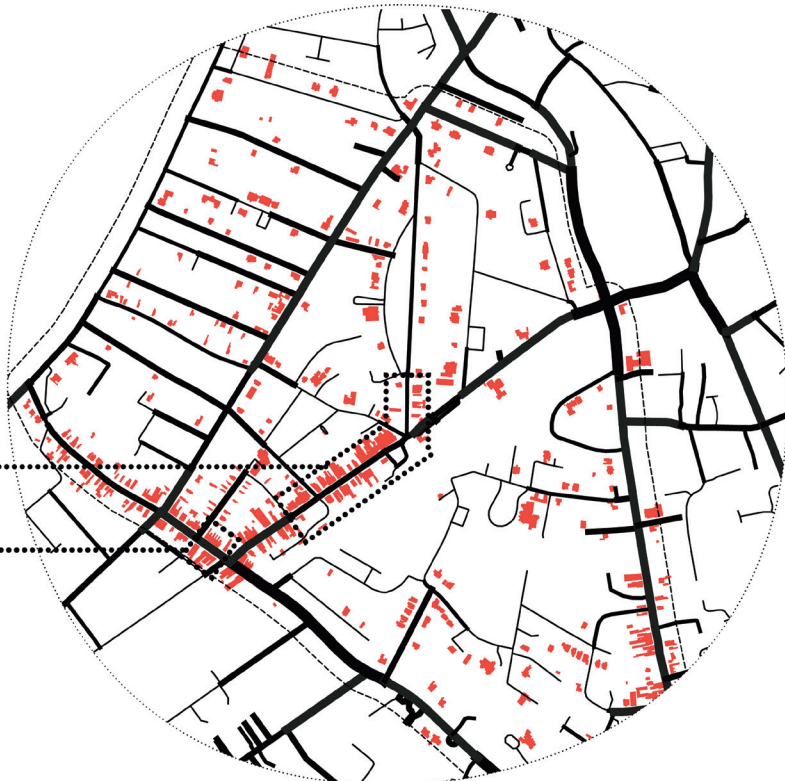
Modern non-domestic uses demand an increasing amount of space which the traditional high street sometimes struggles to accommodate (Griffiths *et al.*, 2013). Another factor that may lie behind the different development trajectories of Surbiton and South Norwood is the contrast in their historical urban forms, stemming from particular historical street configurations. The street centralities in Figures 2, 6 and 7 illustrate that South Norwood has adhered tightly to a junction of arterial roads, whereas Surbiton is sandwiched between its closest main roads. Surbiton also has a robust network of well-connected streets between the arterial roads, whereas South Norwood has only a thin corridor of maximal choice. As a result, Surbiton has many more buildings on middle-to-high choice streets (Figure 8). There are more buildings in Surbiton on streets that are not traffic arteries, but are likely to attract passers-by through them, so providing desirable locations both for dwellings and businesses. Moreover, Surbiton has a greater number of sizeable plots that influence physical change by providing surplus space and access to the plot (Figure 8), so more buildings have the potential for physical adaptation. In summary, it appears that greater redundancy in accessibility to buildings in the town centre and favourable plots in the high street have rendered Surbiton more physically changeable.

#### *Functional changeability*

It has been hypothesized that the accessibility and intelligibility of the street network makes a centre functional, and that access to building density and the presence of people bring it alive. But a situation with levels of choice






**Surbiton**

Claremont Road  
& Victoria Road  
Brighton Road



**South Norwood**

High Street  
Portland Road

-  Modified building
-  Low choice value
-  High choice value
-  High street segments
-  Survey area



**Figure 6. Modifications between c. 1880 and 2013 in the town centres, and choice at 2 km radius (2013).**

### Surbiton

Claremont Road  
& Victoria Road

Brighton Road



### South Norwood

High Street

Portland Road

■ Demolished building

— Low choice value

▬ High choice value

⋯ High street segments

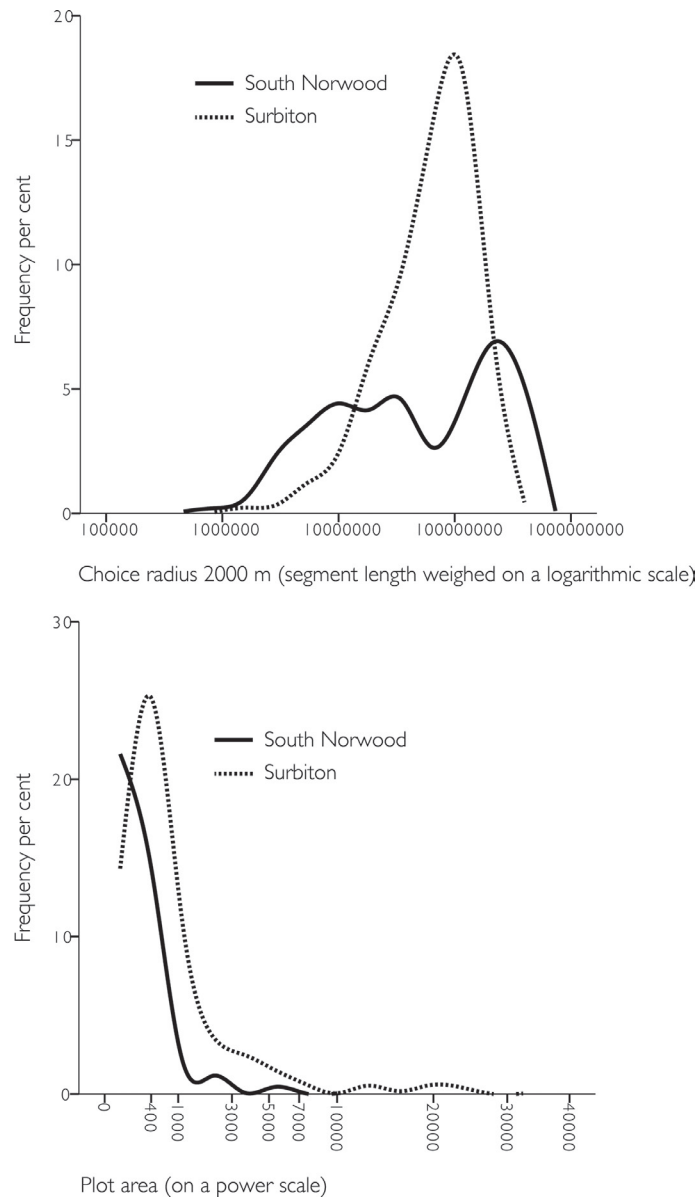
□ Survey area



1km



**Figure 7. Demolitions between c. 1880 and 2013 in the town centres, and choice at 2 km radius (2013).**



**Figure 8. The choice values of buildings and plot sizes in c. 1880 to 2013.**

that are too high can actually be detrimental to land-use diversity, by generating too much change for a diverse local mix to evolve over time (Hall, 2011; Marcus, 2010; Penn *et al.*, 2009; Vaughan and Griffiths, 2013). Figure 9 shows that use change is indeed more strongly associated with central streets than with building demolition or modification. The findings support earlier research, and demonstrate how even fine-grained differences in the choice value of the street network can have an

influence on land-use diversity and functional changeability.

The two case-study centres have similar ratios of land-use change. However, Surbiton’s high street segments (especially Victoria Road) have a more balanced mixture of change and long-term continuity of uses. The characteristic differences of the centres, namely that Surbiton has relatively more buildings on medium to high levels of choice (rather than highest choice), renders Surbiton

more balanced in affording the spatial conditions of continuity and change needed to generate socio-economic diversity.

The imbalance in use change and continuity in South Norwood may stem from the fact that the junction of the two main streets was the original focal point of the centre. The railway cuts across the junction, disrupting the continuity between the two main streets with the effect that they resemble two different (even rival) centres rather than one single centre. Surbiton's centre is on one side of the railway line and its station opens directly to the high street, whereas South Norwood's station is some distance from its high street.

### *Social changeability*

Change in the social use of space is difficult to assess empirically – in particular due to the lack of fine-grained historical data. It has been hypothesized that a gradient from seclusion to co-presence of people, and from informal to formal spaces, would create a socially rich environment (Vaughan, 2015, ch. 2; Vaughan and Griffiths, 2013). The two centres do not differ much in their potential for structuring co-presence: they have very similar correlations of integration and choice centralities at various search distances (Dhanani and Vaughan, 2013). Non-domestic buildings in South Norwood were found to exploit a slightly wider range of integration, which could have meant that South Norwood had a potential for a richer social environment. Yet Surbiton today appears to afford a more dynamic socio-economic environment – an indication perhaps of its morphological changeability.

A structured video study of the town centres took place in June/July 2008. The study entailed multi-directional filming from a fixed tripod – three times a day over three mid-week days – at a range of locations around each town centre, in order to capture pedestrian movement and social activity. Analysis of the footage revealed a marked contrast between the two centres, with a bustling mixture of shoppers, local people and workers walking around Surbiton's town centre, whilst

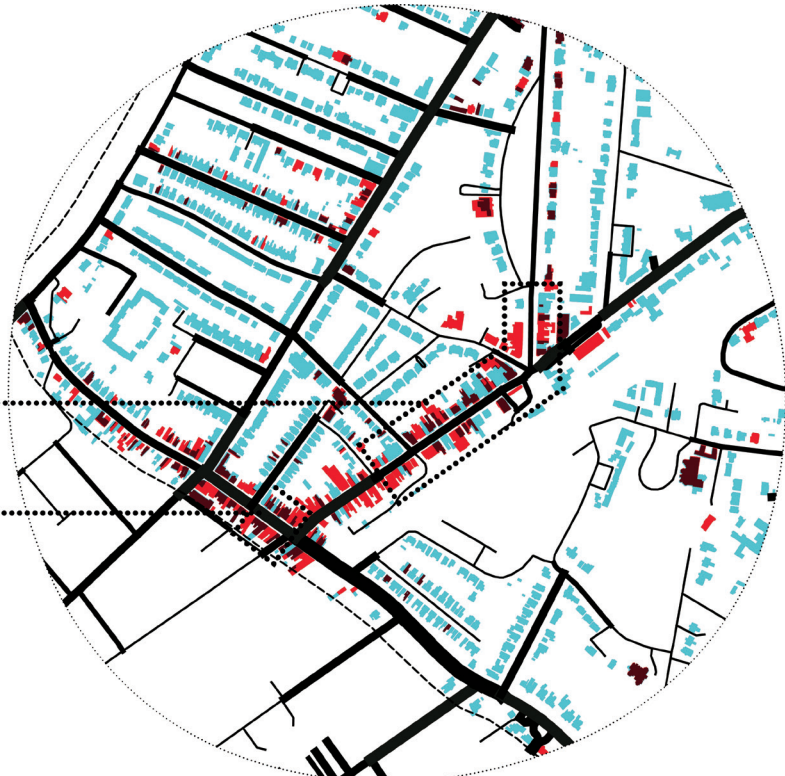
movement in South Norwood was mainly by commuters or people passing through to catch buses or trains, with few stopping to use the town centre's facilities. A questionnaire study carried out in September 2008 for a sample of 199 people across three town centres (High Barnet was another case studied) asked respondents the purposes of their visit. It revealed that – as reported in Vaughan *et al.* (2010a, p. 12) – '46% mentioned shopping as one or more of their activities, yet, of those, only 16... 'just' shop... 86% of shoppers were doing something else as a by-product of their shopping (or vice versa)'. Respondents were also asked to trace their walk from their point of origin to the town centre. Figure 10 shows those routes for which respondents had mentioned more than one purpose for their trip. It illustrates the difference between the two high streets (Victoria Road in Surbiton and South Norwood High Street). Whilst Surbiton's high street and adjacent roads are well used, South Norwood's High Street rarely features in reported routes. It appears to lack visibility, in contrast to Surbiton with its strong connections to a residential hinterland.

The reasons for the problems of socio-economic viability facing South Norwood's main streets are complex. Besides reflecting a lesser degree of typomorphological and functional changeability when compared to Surbiton, there are many other variables that were not explored in this research. For example, a cause of the difficulties may be the fact that South Norwood's High Street, to the north side of the railway, is not the focal point of building densities: the earliest and densest development is around what is today a secondary town centre, on Portland Road to the south. This means the railway station tends to feed passengers onto the configurationally weaker side of the railway line. Another consideration is middle-class disaffiliation. The late-nineteenth and early-twentieth century developments to the north of the centre contain more expensive housing. One might conclude that the railway provided the newly arrived middle-class with a geographical and physical boundary that amounted to a psychological and functional disaffiliation device

**Surbiton**

Claremont Road  
& Victoria Road

Brighton Road



**South Norwood**

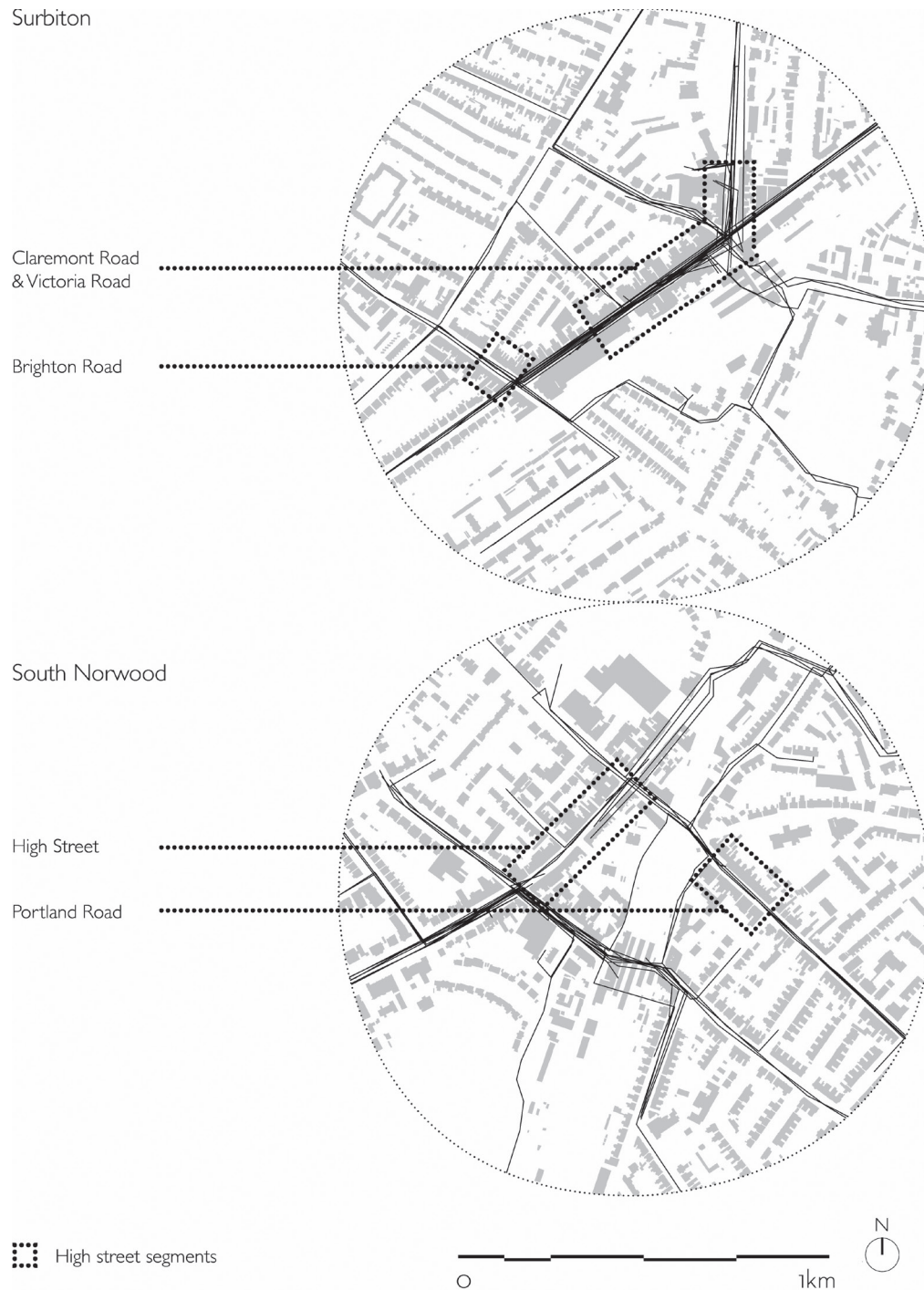
High Street

Portland Road

- Ground floor use
- Changed
- Changed and continued
- Continued
- Low choice value
- High choice value
- High street segments
- Survey area



**Figure 9. Use changes between c. 1880 and 2013 in the town centres, and choice at 2 km radius (2013).**



The movement traces are recorded in 2008 and 2010. Copyright of the "Towards Successful Suburban Town Centres" project funded by EPSRC (reference: EP/D06595X/1; with permission from Prof. L.Vaughan).

Background map © Crown Copyright/database right 2014. An Ordnance Survey/EDINA supplied service.

**Figure 10. Reported routes of people undertaking multiple activities during their walk (Surbiton: n=63; South Norwood: n=56). Movement traces are recorded in 2008 and 2010: copyright EPSRC project on 'Towards successful suburban town centres' (reference EP/D06595X/1). Background map Crown Copyright 2014 (an Ordnance Survey/EDINA service).**

between the south side and the north, where the high street – named High Street in the mid-1860s (Croydon Council, 2008) – is situated (Sies, 1997; Watt, 2009).

In contrast, Surbiton was a single development on open fields. Its uniform initial planning may have been the very stimulus that has kept it exclusive. Indeed it may be an illustration of the argument that a continuing commitment to developing one's neighbourhood contributes to the persistence of exclusive suburban settlements (Sies, 1997). If such a commitment existed, it may have been an important reason why the buildings in Surbiton's high street have been continuously improved, whereas there is less evidence of this in South Norwood.

## Conclusion

Of the two centres under consideration, Surbiton has sustained its original socio-economic character more than South Norwood. It follows that Surbiton's high street has been more continuously redeveloped, has had a greater balance between continuity and change, and today has greater land-use diversity. Although extrinsically similar, Surbiton and South Norwood have distinctive typomorphologies. Broadly speaking, the centre of South Norwood has grown *around the junction* of arterial roads, while that of Surbiton was planned *between* arterial roads. This disparity may help explain why the centres have adapted differently to changing socio-economic circumstances, such as the transition to national-scale commerce and property markets.

The study found that buildings on active streets with medium-to-high spatial choice have tended to be most changeable: they can accommodate a variety of non-domestic uses that may change or stay for decades – a phenomenon that resembles the accumulation of land-use diversity in little frequented centres (Hall, 2011; Penn *et al.*, 2009). Such streets also foster modifications to buildings and cyclical redevelopment, particularly within wide-fronted plots.

Surbiton's urban form has more instances of what we have defined as 'changeable streets', which have created a functionally and socially resilient centre. In general, lower-level changeability in buildings appears to contribute to the higher-level functional and social robustness of a centre: it stays in a state of continuing morphological transition and re-creates and maintains its potential for change. This vital source of self-sustainability is, we suggest, an essential ingredient of long-term urban viability.

The findings of this study highlight how changeability needs to be understood as a system of interdependencies between different contexts (social, functional and physical) and sub-systems with different dynamics (buildings, street networks and spatial network configuration). Of course, the case studies presented here are both highly specific as suburban locales of Greater London. Useful follow-up research would involve investigating the extent to which similar change patterns are to be found elsewhere. Might it be, one might speculate, that just as a stock of changeable buildings is important for robust town centres, so a stock of changeable town centres that can acquire new meanings and functions is important for robust cities?

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## References

- Allen, S. (1997) 'From object to field', *Architectural Design* 67(5/6), 26–33.
- Conzen, M. R. G. (1960) *Alnwick, Northumberland: a study in town-plan analysis* Institute of British Geographers (George Philip, London).

- Conzen, M. R. G. (1988) 'Morphogenesis, morphological regions and secular human agency in the historic landscape, as exemplified by Ludlow', in Denecke, D. and Shaw, G. (eds) *Urban historical geography* (Cambridge University Press, Cambridge) 255–61.
- Croydon Council (2008) *South Norwood Conservation Area Appraisal and Management Plan* ([http://www.croydon.gov.uk?contents/departments/planningandregeneration/pdf/sth\\_norwoodplan.pdf](http://www.croydon.gov.uk?contents/departments/planningandregeneration/pdf/sth_norwoodplan.pdf)) accessed 8 February 2014.
- Davis, H. (2013) *Living over the store: architecture and local urban life* (Routledge, Abingdon).
- Department for Communities and Local Government (2011) *English indices of deprivation 2010* ([www.communities.gov.uk/publications/corporate/statistics/indices2010](http://www.communities.gov.uk/publications/corporate/statistics/indices2010)) accessed 23 July 2014.
- Dhanani, A. and Vaughan, L. (2013) 'A porous urban fabric: the structures and scales of London's peri-urban development from 1880 to 2013', in Kim, Y. O. and Seo, K. W. (eds) *Proceedings of the Ninth International Space Syntax Symposium* (Sejong University, Seoul) 037:1–20.
- Garcia, M. (2009) 'Prologue for a history, theory and future of patterns of architecture and spatial design', *Architectural Design* 79(6), 6–17.
- Giddens, A. (1984) *The constitution of society* (University of California Press, Berkeley).
- Gort Scott Architects and UCL Bartlett School of Planning (2010) *High street London* (Design for London, Greater London Authority, London).
- Griffiths, S. (2015) 'The high street as a morphological event', in Vaughan, L. (ed.) *Suburban urbanities* (UCL Press, London) 32–50.
- Griffiths, S., Vaughan, L., Haklay, M. and Jones, C. E. (2008) 'The sustainable suburban high street', *Geography Compass* 2(4), 1155–88.
- Griffiths, S., Jones, C. E., Vaughan, L. and Haklay, M. (2010) 'The persistence of suburban centres in Greater London: combining Conzenian and space syntax approaches', *Urban Morphology* 14, 85–99.
- Griffiths, S., Dhanani, A., Ellul, C., Haklay, M., Jeevendrampillai, D. and Nikolova, N. (2013) 'Using space syntax and historical land-use data to interrogate narratives of high street 'decline' in two Greater London suburbs', in Kim, Y. O., Park, H. T. and Seo, K. W. (eds) *Proceedings of the Ninth International Space Syntax Symposium* (Sejong University, Seoul) 036:1–15.
- Hall, S. M. (2011) 'High street adaptations: ethnicity, independent retail practices, and localism in London's urban margins', *Environment and Planning A* 43, 2571–88.
- Hillier, B. (1996) *Space is the machine: a configurational theory of architecture* (Cambridge University Press, Cambridge).
- Hillier, B. (1999) 'Centrality as a process: accounting for attraction inequalities in deformed grids', *Urban Design International* 4(3), 107–27.
- Hillier, B. (2009) 'Spatial sustainability in cities: organic patterns and sustainable forms', in Koch, D., Marcus, L. and Steen, J. (eds) *Proceedings of the 7th International Space Syntax Symposium* (Royal Institute of Technology, Stockholm) June, K01-20.
- Hillier, B. and Hanson, J. (1984) *The social logic of space* (Cambridge University Press, Cambridge).
- Hillier, B. and Iida, S. (2005) 'Network and psychological effects in urban movement', *Lecture Notes in Computer Science, COSIT 2005, LNCS 3693*, 475–90.
- Holliss, F. (2015) *Beyond live/work* (London, Routledge).
- Jacobs, J. (1993) *The death and life of great American cities* (Modern Library, New York).
- Jones, P. (2007) *Link and place: a guide to street planning and design* (Local Transport Today, London).
- Kelly's London Suburban Directory (1915) (Kelly's Directories Ltd, London).
- Kelly's London Suburban Directory (1956) (Kelly's Directories Ltd, London).
- Krenz, K. (2015) 'Capturing patterns of shrinkage and growth in post-industrial regions', *Proceedings of the 10th International Space Syntax Symposium* (Space Syntax Laboratory, Bartlett School of Architecture, University College London, London) 72:1–18.
- Kropf, K. S. (2001) 'Conceptions of change in the built environment', *Urban Morphology* 5, 29–42.
- Lean, W. K. and Goodall, B. (1966) *Aspects of land economics* (Estates Gazette, London).
- Lefebvre, H. (1991) *The production of space* (Blackwell, Oxford).
- Lefebvre, H. (2009) 'Space: social product and use value', in Brenner, N. and Elden, S. (eds) *Space, state, world: selected essays* (University of Minnesota Press, Minneapolis) 185–95.
- Marcus, L. (2010) 'Spatial capital: a proposal for an extension of space syntax into a more general urban morphology', *Journal of Space Syntax* 1, 30–40.

- Moudon, A. V. (1989) 'The role of typomorphological studies in environmental design research', in Hardie, G., Moore, R. and Sanoff, H. (eds) *Changing paradigms: EDRA 20/1989: proceedings of annual conference* (Environmental Design Research Association, Oklahoma City) 41–8.
- Ordnance Survey County Series, 1st, 2nd and 3rd edns [TIFF geospatial data], scale 1:2500 (1879, 1913 and 1954). OS National Grid 1 km tiles TQ3368 and TQ3468 (Landmark Information Group, UK). Using: EDINA Historic Digimap Service (<http://edina.ac.uk/digimap>).
- Ordnance Survey County Series, 1st, 2nd and 3rd edns [TIFF geospatial data], scale 1:2500 (1880, 1913 and 1955). OS National Grid 1 km tiles TQ1867 and TQ1767 (Landmark Information Group, UK). Using: EDINA Historic Digimap Service (<http://edina.ac.uk/digimap>).
- Ordnance Survey MasterMap Topography Layer [GML geospatial data], coverage: Surbiton and South Norwood (updated 2013) (Ordnance Survey, GB). Using: EDINA Digimap Ordnance Survey Service (<http://edina.ac.uk/digimap>).
- Penn, A., Perdikogianni, I. and Mottram, C. (2009) 'The generation of diversity', in Cooper, R., Evans, G. and Boyko, C. (eds) *Designing sustainable cities* (Wiley-Blackwell, Chichester) 218–37.
- Phillipson's Almanack and Directory for Kingston & Neighbourhood (1876) (G. Phillipson & Sons, Kingston-on-Thames).
- Porta, S. and Romice, O. (2010) *Plot-based urbanism: towards time-consciousness in place-making* Working paper (University of Strathclyde, Glasgow).
- Ross, A. M., Rhodes, D. H. and Hastings, D. E. (2008) 'Defining system changeability: reconciling, flexibility, adaptability, scalability, and robustness for maintaining system life-cycle value', *Systems Engineering* 3(11), 246–62.
- Schmidt, R., Eguchi, T., Austin, S. and Gibb, A. (2010) 'What is the meaning of adaptability in the building industry?', *Proceedings of the 16th International Conference of the CIB W104 Open Building Implementation on 'Open and Sustainable Building'* (Labein Tecnalia, Derio, Spain) May, 223–42.
- Schneider, T. and Till, J. (2007) *Flexible housing* (Taylor and Francis, London).
- Seamon, D. (1979) *A geography of the lifeworld* (Croom Helm, London).
- Sies, M. C. (1997) 'Paradise retained: an analysis of persistence in planned, exclusive suburbs, 1880–1980', *Planning Perspectives* 12, 165–91.
- Siksna, A. (1998) 'City centre blocks and their evolution: a comparative study of eight American and Australian CBDs', *Journal of Urban Design* 3, 253–83.
- Smeets, J. (2007) 'Sustainable residential areas and course of life', unpublished paper presented to the European Network for Housing Research Conference on Sustainable Urban Areas, Rotterdam ([http://www.enhr2007rotterdam.nl/documents/W08\\_paper\\_Smeets.pdf](http://www.enhr2007rotterdam.nl/documents/W08_paper_Smeets.pdf)) accessed 14 June 2011.
- Switzer, J. F. Q. (1963) 'The life of buildings in an expanding economy', *Chartered Surveyor* 96, 70–7.
- Thurstain-Goodwin, M., Batty, M., Haklay, M., Lloyd, D., Boott, R., Hyman, A., Batty, S., Tomalin, C., Cadell, C., Falk, N., Sheppard, S. and Curtis, S. (2002) *Producing boundaries and statistics for town centres* (The Stationery Office, London).
- Törmä, I. (2011) 'Diversity and connectedness as the flexibility of built environments', in Gibson, M. D. and Kendall, S. (eds) *Architecture in the fourth dimension: methods and practices for a sustainable building stock* (Muncie, Indiana) 77–82.
- Varoudis, T. (2011–14) *DepthmapX multi-platform spatial network analysis software* (<http://varoudis.github.io/depthmapX/>) accessed 20 August 2013.
- Vaughan, L. (ed.) (2015) *Suburban urbanities* (UCL Press, London).
- Vaughan, L. and Griffiths, S. (2013) 'A suburb is not a tree', *Urban Design Group Quarterly* 125, 17–9.
- Vaughan, L., Haklay, M., Griffiths, S. and Jones, C. E. (2010a) 'The shape of belonging in the outer London suburbs: beyond a discourse of alienation', unpublished paper presented to the Public Life in the In-Between-City International Conference (Technion – Israel Institute of Technology, Haifa, Israel) June.
- Vaughan, L., Jones, C. E., Griffiths, S. and Haklay, M. (2010b) 'The spatial signature of suburban town centres', *Journal of Space Syntax* 1, 77–91.
- Verebes, T. (2013) *Masterplanning the adaptive city* (London, Routledge).
- Ward's Commercial & General Croydon Directory (1874) (R. Ward & Sons, Newcastle upon Tyne).
- Ward's Commercial & General Croydon Directory (1915) (R. Ward & Sons, Newcastle upon Tyne).

- Ward's Commercial & General Croydon Directory (1956) (R. Ward & Sons, Newcastle upon Tyne).
- Watt, P. (2009) 'Living in an oasis: middle-class disaffiliation and selective belonging in an English suburb', *Environment and Planning A*, 41, 2874–92.
- Whitehand, J. W. R. (1984) 'Commercial townscapes in the making', *Journal of Historical Geography* 10, 174–200.
- Whitehand, J. W. R. (2001a) 'British urban morphology: the Conzenian tradition', *Urban Morphology* 5, 103–9.
- Whitehand, J. W. R. (2001b) 'Changing suburban landscapes at the microscale', *Tijdschrift voor Economische en Sociale Geografie* 92, 164–84.
- Whitehand, J. W. R. and Carr, C. M. H. (2001) *Twentieth-century suburbs* (Routledge, London).
- Whitehand, J. W. R. and Whitehand, S. M. (1984) 'The physical fabric of town centres: the agents of change', *Transactions of the Institute of British Geographers* 9, 231–47.
-